

Optics

Smart Optics Material Characterization System

A flexible, unified platform for dynamic smart optical material evaluation

NASA's Langley Research Center has developed an adaptable and powerful interferometric test platform that uniquely enables multi-parameter evaluation of a wide variety of smart optical materials (SOM). The patent-pending SOM characterization system was created to measure the dynamic optical response of stimuli-responsive ("smart") optical materials while external physical/electrical/thermal/chemical/pressure/magneto stimuli are applied to the material. Using novel interferometric fringe analysis software and a multi-stimuli-capable SOM test cell, the SOM characterization system enables a wide variety of materials - such as liquid crystals, nonlinear crystals, electro- and thermo-active polymer optics, and magneto- or piezo-driven optics - to be optically characterized for real-time changes in intensity, phase, and polarization. The versatility of the SOM test platform combined with the powerful, efficient, and user-friendly software interface make it a valuable tool for the research or commercial development of smart materials.

BENEFITS

- ➔ Multi-parameter characterization -
Evaluation of up to 10 key optical parameters - index of refraction, optical intensity, phase, and polarization - from a single interferometric data set
- ➔ Powerful control, analysis, visualization, and user interface software -
Dynamic smart optical material test cell control combined with powerful interferometric fringe analysis and data visualizations via page driven menu
- ➔ Flexible, but material specific test platform for evaluating smart optical materials - Using a common optical platform and multi-stimuli test cell the system provides full aperture (20-50 mm), full transmitted or reflected wavefront measurements

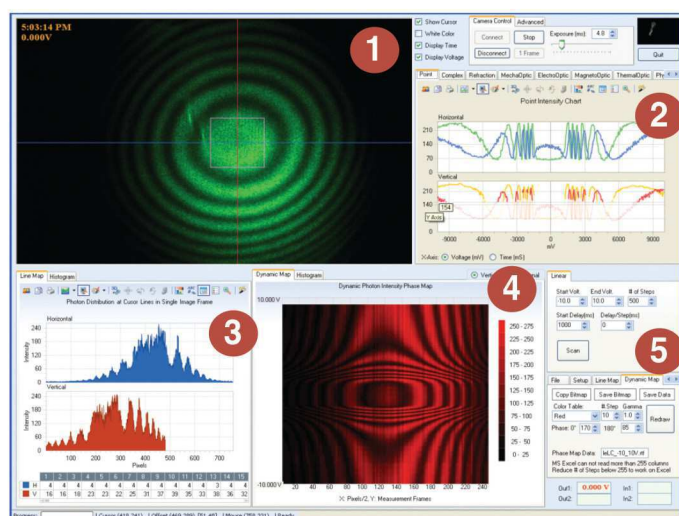
technology solution



THE TECHNOLOGY

Smart materials, those that respond to controlled external stimuli (pressure, temperature, light, electric field, pH, magnetic field, etc.) have enabled a wide variety of new imaging, switching, and sensing systems based on smart optical materials (SOM). Typical interferometers, ellipsometers, and polarimeters offer limited sensitivities and capabilities for the dynamic, multi-parameter characterization desirable for the many SOMs in use today. To address this limitation and to advance SOM development NASA Langley has designed the patent SOM Characterization System.

Using a Michelson interferometer platform and a single custom SOM test cell, capable of providing multiple types of external stimuli, the advanced characterization system software dynamically controls stimuli (e.g. physical, electrical, thermal, magneto, chemical) to the SOM under test and then measures the resulting changes in intensity, phase angle, polarization state, and coherence of the transmitted or reflected light. The accompanying software records and analyzes the dynamic change of interference patterns on multiple pixels in a time sequence as the stimuli are applied and presents a Phase/Intensity Time Ripple Map for the smart optical material under test. The SOM Characterization System provides variable (milli-seconds to hours) acquisition rates for multi-point, full aperture, measurements.



Smart Optical Material Fringe Analysis and Visualization Software User Interface

APPLICATIONS

The technology has several potential applications:

- Tailorability of the materials allows for innovation of new products:
- Optical metrology - smart optical materials measurement and evaluation
- Telecommunications - nonlinear and liquid crystal switching and waveguide device testing
- 2D/3D displays - liquid crystal materials, 2D pixel arrays, and device testing
- Precision and adaptive optics - active and adaptive materials and component evaluation
- Sensors and detectors - evaluation of stimuli-responsive materials used in sensors and detectors

PUBLICATIONS

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